I (WE) CLAIM:

- 1. A method for computing spatial derivatives for medical imaging, the method comprising:
- (a) determining a spatial gradient vector in an acoustic domain for at least one ultrasound data sample; and
- (b) transforming the spatial gradient vector to a Cartesian coordinate system.
- 2. The method of Claim 1 further comprising:
- (c) volume rendering ultrasound data, including the at least one ultrasound data sample, as a function of the transformed spatial gradient vector from (b).
- 3. The method of Claim 2 wherein (c) comprises volume rendering with shading, the shading being a function of the transformed spatial gradient vector.
- 4. The method of Claim 1 further comprising:
- (c) generating a two dimensional image from ultrasound data, including the at least one ultrasound data sample, as a function of the transformed spatial gradient vector from (b).
- 5. The method of Claim 1 further comprising:
- (c) filtering ultrasound data, including the at least one ultrasound data sample, as a function of the transformed spatial gradient vector from (b), the filtering operable to perform at least one of: speckle reduction, feature enhancement and edge enhancement.
- 6. The method of Claim 1 wherein (a) comprises calculating a derivative of ultrasound data associated with the at least one ultrasound data sample, the derivative along one of: azimuth angle, range and elevation angle.

- 7. The method of Claim 6 wherein (a) comprises calculating a derivative of the order at least one as a function of azimuth angle and a second derivative as a function of range.
- 8. The method of Claim 1 wherein (b) comprises weighting the spatial gradient vector of the acoustic domain as a function of a relationship of an acoustic grid to the Cartesian coordinate system.
- 9. The method of Claim 1 wherein (b) comprises calculating two spatial derivatives in the Cartesian coordinate system as a function of multiplying at least two spatial gradient vectors in the acoustic domain by a matrix.
- 10. The method of Claim 9 wherein (b) comprises using a matrix representing spatial differences between the acoustic domain and the Cartesian coordinate system.
- 11. The method of Claim 1 further comprising:
- (c) performing (b) with one of a programmable fragment shader, a vertex shader and combinations thereof of a graphics processing unit.
- 12. The method of Claim 1 further comprising:
- (c) generating a three-dimensional representation from ultrasound data, including the at least one ultrasound data sample, in the acoustic domain without scan conversion of ultrasound data representing two-dimensional regions.
- 13. In a method for computing spatial derivatives for medical ultrasound imaging, the improvement comprising:
- (a) calculating a spatial gradient vector representing a gradient in a Cartesian coordinate space from ultrasound data in the acoustic domain, the ultrasound data being free of scan conversion.

14. A system for computing spatial derivatives for medical ultrasound imaging, the system comprising:

a receive beamformer operable to output ultrasound data in an acoustic domain;

a graphic processor unit connected with the receive beamformer, the graphics processor unit operable to determining a spatial gradient vector in the acoustic domain from the ultrasound data and operable to transform the spatial gradient vector to a Cartesian coordinate system.

- 15. A method for computing spatial derivatives for medical ultrasound imaging, the method comprising:
- (a) resampling ultrasound data in an acoustic domain to ray-lines representing a viewing angle through a volume; and
- (b) determining gradient information from the resampled ultrasound data.
- 16. The method of Claim 15 further comprising:
- (c) determining values along the ray-lines as a function of the resampled ultrasound data and the gradient information; and
 - (d) blending along the ray-lines with the values of (c).
- 17. The method of Claim 15 further comprising:
- (c) delaying resampled ultrasound data from adjacent ray-lines; wherein (b) comprises determining the gradient information from the delayed resampled ultrasound data.
- 18. The method of Claim 15 wherein (b) comprises determining first and second gradients along first, second and third dimensions.
- 19. The method of Claim 15 further comprising:
- (c) shading the resampled ultrasound data as a function of the gradient information.

20. The method of Claim 15 wherein (b) comprises determining gradients from ultrasound data in a screen domain, the ultrasound data in the screen domain being a two dimensional representation of a three dimensional volume;

further comprising:

- (c) shading the ultrasound data as a function of the gradients.
- 21. A method for computing spatial derivatives for medical ultrasound imaging, the method comprising:
- (a) shading ultrasound data representing a three dimensional volume; and
- (b) resampling the shaded ultrasound data to ray-lines representing a viewing angle through the three dimensional volume.
- 22. The method of Claim 21 further comprising:
 - (c) blending the shaded, resampled ultrasound data along the ray-lines.
- 23. The method of Claim 21 wherein (a) comprises shading one of: display intensities with opacity weights and display intensities with transparency weights.
- 24. The method of Claim 21 wherein (a) comprises shading ultrasound data in an acoustic domain and free of two-dimensional scan conversion.
- 25. The method of Claim 21 further comprising:
- (c) determining gradients for the ultrasound data; wherein (a) comprises altering the ultrasound data as a function of the gradients.
- 26. The method of Claim 1 further comprising:
 - (c) performing (b) with a programmable vertex shader of a graphics processing unit.

- 27. The method of Claim 1 further comprising:
 - (c) performing (b) with programmable vertex and fragment shaders of a graphics processing unit.